

(12) **United States Patent**  
**Resutek et al.**

(10) **Patent No.:** **US 10,144,271 B2**  
(45) **Date of Patent:** **Dec. 4, 2018**

(54) **VALVE-IN-RECEIVER FOR A VEHICLE CLIMATE CONTROL SYSTEM**

*F25B 43/006* (2013.01); *B60H 2001/3291* (2013.01); *F25B 2400/053* (2013.01); *F25B 2400/054* (2013.01); *F25B 2400/16* (2013.01); *F25B 2400/162* (2013.01); *F25B 2500/18* (2013.01)

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(58) **Field of Classification Search**  
CPC ..... B60H 1/3204; B60H 1/00485; B60H 2001/3291; F28D 9/005; F25B 47/022; F25B 45/00; F25B 43/003; F25B 43/006; F25B 2500/16  
See application file for complete search history.

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(\* ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 26 days.

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(21) Appl. No.: **15/282,424**

(22) Filed: **Sep. 30, 2016**

(65) **Prior Publication Data**  
US 2018/0093549 A1 Apr. 5, 2018

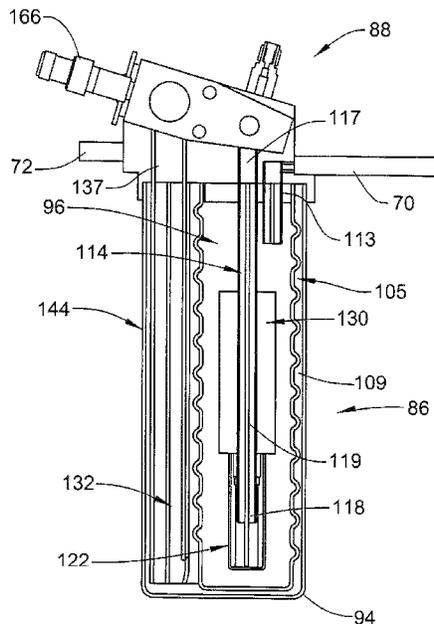
\* cited by examiner  
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(51) **Int. Cl.**  
*B60H 1/32* (2006.01)  
*B60H 1/00* (2006.01)  
*F25B 43/00* (2006.01)  
*F25B 40/00* (2006.01)  
*F25B 41/06* (2006.01)

(52) **U.S. Cl.**  
CPC ..... *B60H 1/3204* (2013.01); *B60H 1/00485* (2013.01); *F25B 40/00* (2013.01); *F25B 41/062* (2013.01); *F25B 43/003* (2013.01);

(57) **ABSTRACT**  
A valve-in-receiver (VIR) for a vehicle climate control system includes a receiver drier (RD) shell including an outer surface and an inner surface defining an interior portion having an opening, and a cap member mounted to the RD shell across the opening, the cap member including an evaporator inlet portion, an evaporator outlet portion, a condenser inlet and a compressor outlet.

**20 Claims, 4 Drawing Sheets**



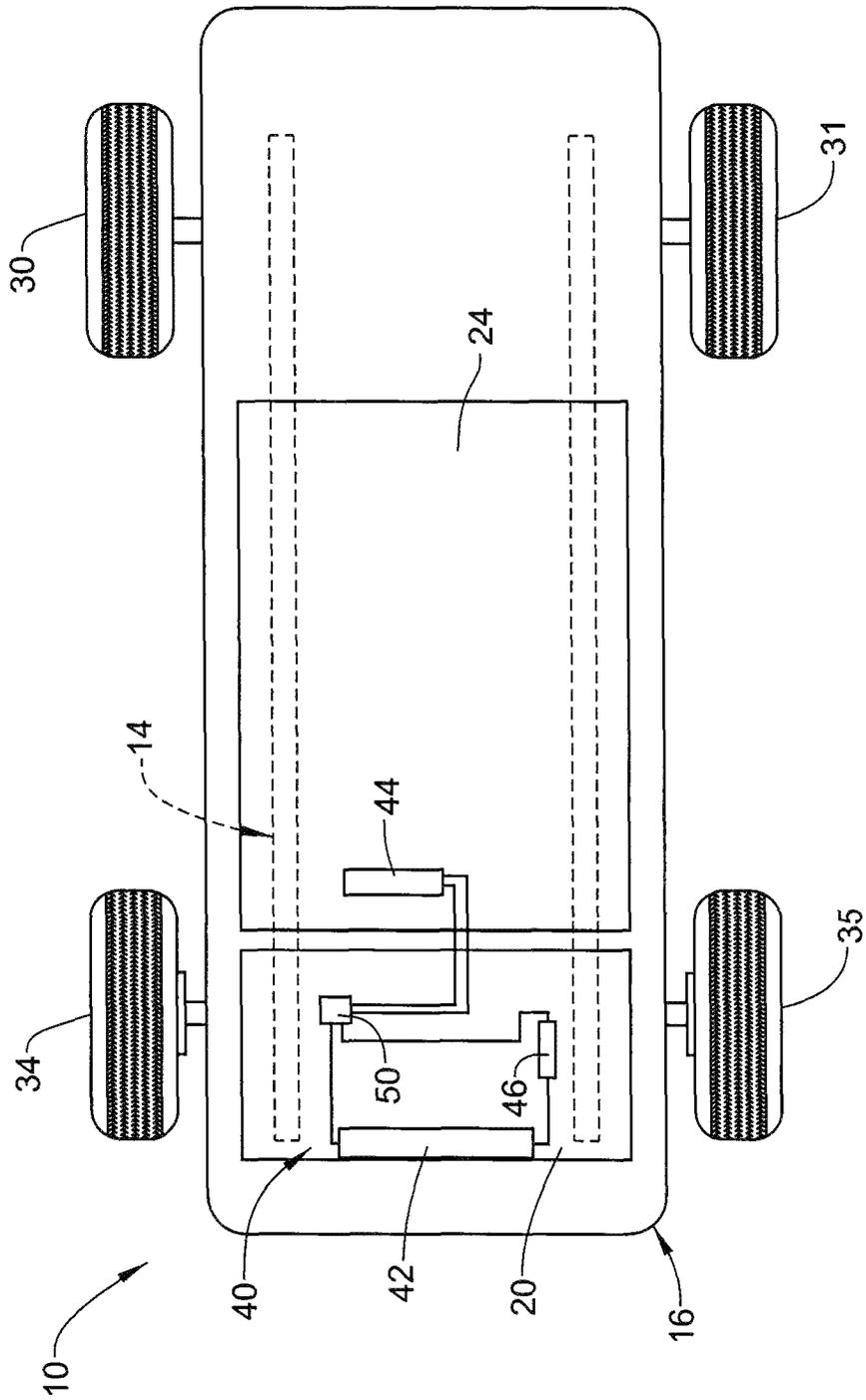


FIG. 1

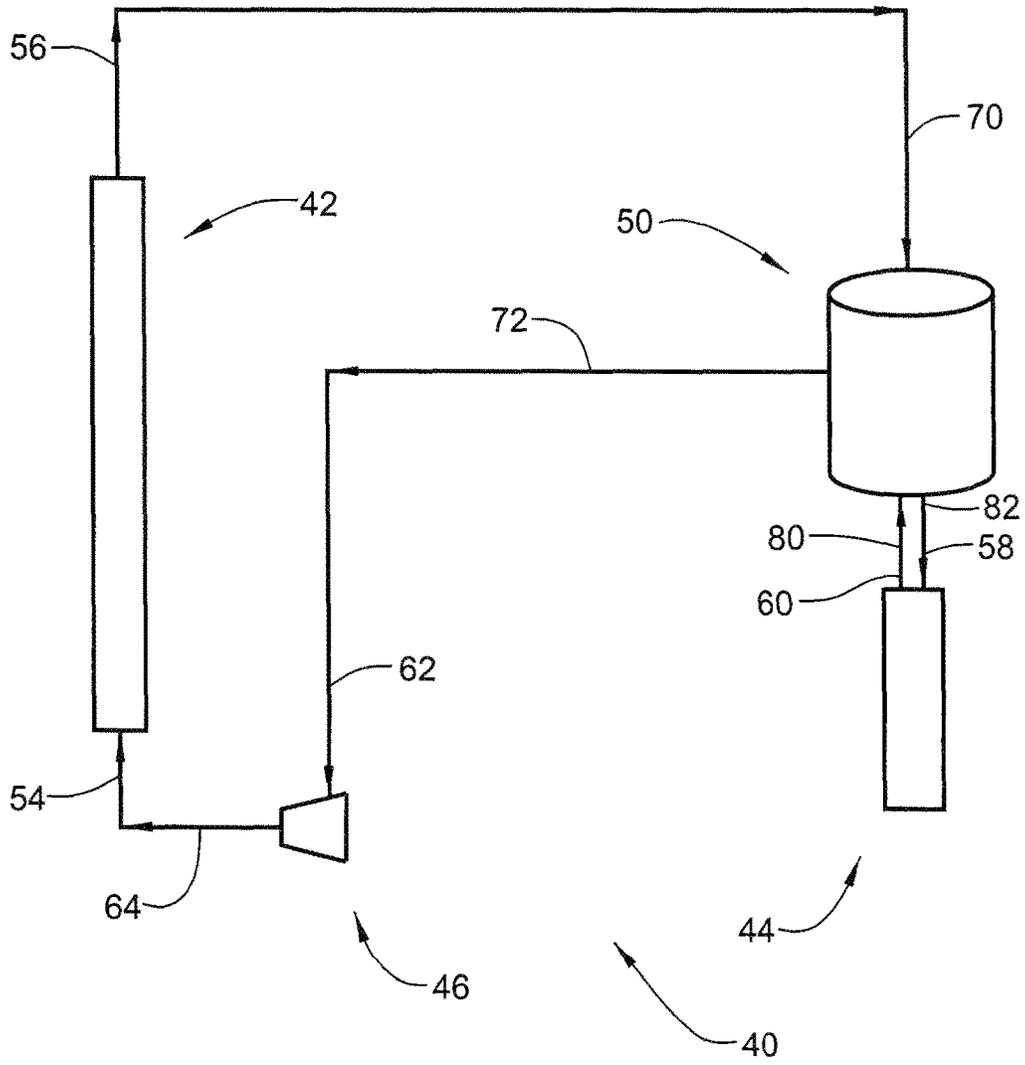


FIG. 2

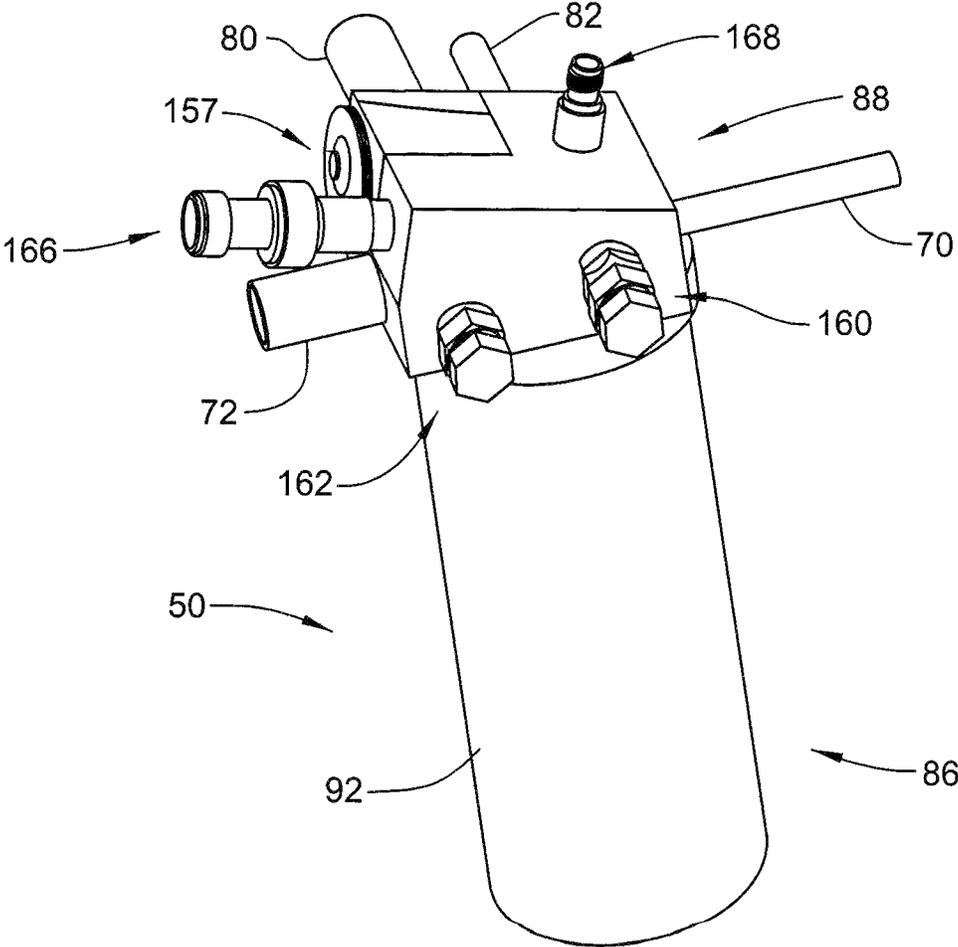


FIG. 3

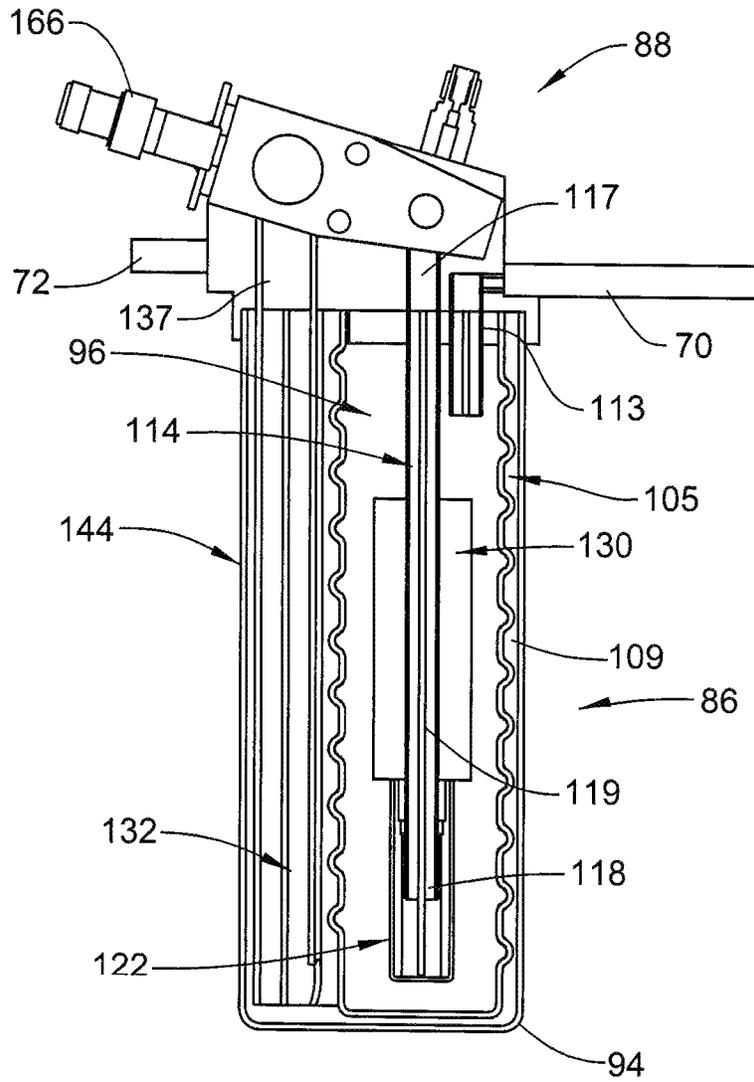


FIG. 4

## VALVE-IN-RECEIVER FOR A VEHICLE CLIMATE CONTROL SYSTEM

### FIELD OF THE INVENTION

The subject invention relates to the art of vehicles and, more particularly, to a valve-in-receiver for a vehicle climate control system.

### BACKGROUND

Most modern vehicles include a climate control system having a heating option and a cooling option. The cooling option is typically embodied by an air conditioning system in which heat is exchanged with a refrigerant passing through an evaporator located in a cabin area. A flow of air is directed over the evaporator into the occupant area. Air conditioning systems include a number of components that work together to provide a desired cooling effect to occupants. Many of the components are co-located with a prime mover or motor for the vehicle in an engine or motor compartment. In addition to the prime mover, other under hood systems such as drive train components, exhaust treatment components, and the like share engine compartment real estate with the climate control systems. Access to repair and/or replace vehicle components has become increasingly difficult as under hood systems increase in number. Accordingly, it is desirable to provide a climate control system with fewer under hood components.

### SUMMARY OF THE INVENTION

In accordance with an exemplary embodiment, a valve-in-receiver (VIR) for a vehicle climate control system includes a receiver drier (RD) shell including an outer surface and an inner surface defining an interior portion having an opening, and a cap member mounted to the RD shell across the opening, the cap member including an evaporator inlet portion, an evaporator outlet portion, a condenser inlet and a compressor outlet.

In accordance with an aspect of an exemplary embodiment, a climate control system for a vehicle includes a condenser including a condenser outlet portion, a compressor including a compressor inlet portion and a compressor outlet portion. The compressor outlet portion is fluidically connected to the condenser. An evaporator includes an evaporator inlet portion and an evaporator outlet portion. A valve-in-receiver (VIR) is fluidically coupled to the condenser, the compressor and the evaporator. The VIR includes a receiver drier (RD) shell including an outer surface and an inner surface defining an interior portion having an opening, and a cap member mounted to the RD shell across the opening. The cap member includes an evaporator inlet fluidically connected to the evaporator outlet portion, an evaporator outlet fluidically connected to the evaporator inlet portion, a condenser inlet fluidically connected to the condenser outlet portion and a compressor outlet fluidically connected to the compressor inlet portion.

In accordance with another aspect of an exemplary embodiment, a vehicle includes a chassis, a body supported by the chassis. The body includes an motor compartment and an occupant zone. A climate control system is supported by the body. The climate control system includes a condenser arranged in the motor compartment, the condenser including a condenser outlet portion, and a compressor arranged in the motor compartment. The compressor includes a compressor inlet portion and a compressor outlet

portion. The compressor outlet portion is fluidically connected to the condenser. An evaporator is arranged in the occupant zone. The evaporator includes an evaporator inlet portion and an evaporator outlet portion. A valve-in-receiver (VIR) is fluidically coupled to the condenser, the compressor and the evaporator. The VIR includes a receiver drier (RD) shell including an outer surface and an inner surface defining an interior portion having an opening, and a cap member mounted to the RD shell across the opening. The cap member includes an evaporator inlet fluidically connected to the evaporator outlet portion, an evaporator outlet fluidically connected to the evaporator inlet portion, a condenser inlet fluidically connected to the condenser outlet portion and a compressor outlet fluidically connected to the compressor inlet portion.

The above features and advantages and other features and advantages of the invention are readily apparent from the following detailed description of the invention when taken in connection with the accompanying drawings.

### BRIEF DESCRIPTION OF THE DRAWINGS

Other features, advantages and details appear, by way of example only, in the following detailed description of embodiments, the detailed description referring to the drawings in which:

FIG. 1 is a schematic diagram of a vehicle having a climate control system provided with a valve-in-receiver (VIR), in accordance with an exemplary embodiment;

FIG. 2 is a schematic diagram depicting the climate control system of FIG. 1;

FIG. 3 is a perspective view of the VIR of FIG. 1, in accordance with an aspect of an exemplary embodiment; and

FIG. 4 is a partial cross-sectional view of the VIR of FIG. 3, in accordance with an aspect of an exemplary embodiment.

### DESCRIPTION OF THE EMBODIMENTS

The following description is merely exemplary in nature and is not intended to limit the present disclosure, its application or uses. It should be understood that throughout the drawings, corresponding reference numerals indicate like or corresponding parts and features.

A vehicle, in accordance with an exemplary embodiment, is indicated generally at **10** in FIG. 1. Vehicle **10** includes a chassis **14** that supports a body **16** having a motor compartment **20** housing a prime mover (not shown) and an occupant zone **24**. It is to be understood that the prime mover may take on a variety of forms including internal combustion engines, electric motors, hybrid electric motors, clean fuel motors and the like. Vehicle **10** includes first and second rear wheels **30** and **31** as well as first and second front wheels **34** and **35**. Rear wheels **30** and **31** may provide a motive force to vehicle **10**. It is however to be understood that front wheels **34** and **35** may, alternatively provide the motive force or all four wheels **30**, **31**, **34**, and **35** may provide the motive force.

Vehicle **10** includes a climate control system, a portion of which is shown at **40**. Climate control system **40** includes a condenser **42** arranged at a forward portion (not separately labeled) of vehicle **10**, an evaporator **44** which may be arranged in occupant zone **24**, a compressor **46** and a valve-in-receiver (VIR) **50**. VIR **50** receives and stores a portion of liquid refrigerant from condenser **42**. In addition VIR **50** may separate gas and liquid portions of the refrig-

erant and as will be discussed below, VIR 50 substantially prevents debris and moisture from passing to compressor 46.

As shown in FIG. 2, condenser 42 includes a condenser inlet portion 54 and a condenser outlet portion 56. A flow of air passes over/through condenser 42 in a heat exchange relationship with the refrigerant. Evaporator 44 includes an evaporator feed conduit 58 and an evaporator discharge conduit 60. A fan (not shown) delivers a flow of air over/through evaporator 44 in a heat exchange relationship with the refrigerant. The air passes into the occupant zone at a reduced temperature to provide a desired cooling effect. Compressor 46 includes a compressor inlet portion 62 that is fluidically connected with VIR 50 and a compressor outlet portion 64 that is fluidically connected to condenser inlet portion 54.

In accordance with an exemplary aspect, VIR 50 includes a condenser inlet 70 fluidically connected to condenser outlet portion 56, a compressor outlet 72 fluidically connected to compressor inlet portion 62, an evaporator inlet 80 fluidically connected to evaporator discharge conduit 60 and an evaporator outlet 82 fluidically connected to evaporator feed conduit 58. As shown in FIGS. 3 and 4, VIR 50 includes a receiver drier (RD) shell 86 and a cap member 88. Cap member 88 supports condenser inlet 70, compressor outlet 72, evaporator inlet 80 and evaporator outlet 82. Cap member 88 is detachably mounted to RD shell 86 through, for example, interaction between pluralities of threads (not separately labeled).

RD shell 86 includes an outer surface 92 and an inner surface 94 defining an interior portion 96. A drier housing 105 is arranged in interior portion 96. Drier housing 105 is spaced from inner surface 94 by an internal heat exchanger (IHx) passage 109. A first conduit 113 extends into drier housing 105. First conduit 113 is fluidically connected to condenser inlet 70 and receives a flow of refrigerant from condenser 42. A second conduit 114 also extends into drier housing 105. Second conduit 114 includes a first end 117 that fluidically connects with evaporator outlet 82, a second end 118 and an intermediate portion 119 extending therebetween. Second end 118 is connected to a pick-up screen 122 that filters refrigerant passing to evaporator 44.

A desiccant 130 is provided on intermediate portion 119. Desiccant 130 reduces moisture that may be present in the refrigerant. Desiccant 130 may be readily accessed and replaced as needed. It is to be understood that the amount (quantity) and/or type of desiccant may vary. It should also be understood that a filter or screen (not shown) may be provided at desiccant 130. It is also to be understood that exemplary embodiments may also include a non-replaceable desiccant. RD shell 86 also includes an evaporator discharge accumulation portion 132 that receives and may store refrigerant passing from evaporator 44. A compressor discharge conduit 137 extends toward evaporator discharge accumulation portion 132 and delivers refrigerant to compressor outlet 72. Outer surface 92 may define a heat shield for RD shell 86.

In further accordance with an exemplary embodiment, cap member 88, in addition to supporting condenser inlet 70, compressor outlet 72, evaporator inlet 80 and evaporator outlet 82, may also support a number of other components associated with climate control system 40. For example, cap member 88 may support an expansion valve 157, FIG. 3. Expansion valve 157 may take the form of a thermal expansion valve (TXV). It is to be understood that expansion valve 157 may take the form of a mechanically operated expansion valve or an electric/electronic expansion valve. Expansion valve 157 is readily accessible and may be

serviceable. Cap member 88 may also support a high side charge port 160 and a low side charge port 162 to facilitate charging and monitoring of refrigerant. Additionally, cap member 88 may support one or more sensor ports 166 and 168 that may be provided with various sensors that provide data pertaining to climate control system 40.

At this point, it should be understood that the exemplary embodiments describe a valve-in-receiver (VIR) that integrates a number of connections and components in order to simplify a climate control system. Additionally, by incorporating charge ports, sensors, and connections into the cap member, the VIR may be readily serviced and the climate control system may be serviced at a single point thereby simplifying repairs and/or diagnostics. Further, combining multiple climate control components into a single device simplifies plumbing, and enhances access to other under hood components.

While the invention has been described with reference to exemplary embodiments, it will be understood by those skilled in the art that various changes may be made and equivalents may be substituted for elements thereof without departing from the scope of the invention. In addition, many modifications may be made to adapt a particular situation or material to the teachings of the invention without departing from the essential scope thereof. Therefore, it is intended that the invention not be limited to the particular embodiments disclosed, but that the invention will include all embodiments falling within the scope of the application.

What is claimed is:

1. A valve-in-receiver (VIR) for a vehicle climate control system comprising:

a receiver drier (RD) shell including an outer surface and an inner surface defining an interior portion having an opening;

a drier housing arranged in the interior portion; an internal heat exchanger (IHx) passage arranged between the drier housing and the inner surface; and a cap member mounted to the RD shell across the opening, the cap member including an evaporator inlet portion, an evaporator outlet portion, a condenser inlet and a compressor outlet;

a first conduit extending into the drier housing from the cap member, the first conduit being fluidically connected to the condenser inlet; and

a second conduit extending into the drier housing from the cap member, the second conduit being fluidically connected to the evaporator outlet portion.

2. The VIR according to claim 1, further comprising: a selectively removable expansion valve mounted in the cap member.

3. The VIR according to claim 1, further comprising: at least one sensor mounted to the cap member.

4. The VIR according to claim 1, further comprising: a high side charge port mounted to the cap member and a low side charge port mounted to the cap member.

5. The VIR according to claim 1, wherein the drier includes a selectively removable desiccant.

6. The VIR according to claim 5, wherein the second conduit includes a first end, a second end an intermediate portion extending through the drier housing, the first end being fluidically connected to the evaporator outlet portion.

7. The VIR according to claim 6, further comprising: a pick up screen arranged at the second end of the second conduit.

8. The VIR according to claim 1, further comprising: an evaporator discharge accumulation portion arranged in the RD shell, the evaporator discharge accumulation portion

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being fluidically connected with the evaporator inlet portion and the evaporator outlet portion.

9. A climate control system for a vehicle, the climate control system comprising:

- a condenser including a condenser outlet portion;
- a compressor including a compressor inlet portion and a compressor outlet portion, the compressor outlet portion being fluidically connected to the condenser;
- an evaporator including an evaporator inlet portion and an evaporator outlet portion; and
- a valve-in-receiver (VIR) fluidically coupled to the condenser, the compressor and the evaporator, the VIR comprising:
  - a receiver drier (RD) shell including an outer surface and an inner surface defining an interior portion having an opening;
  - a drier housing arranged in the interior portion;
  - an internal heat exchanger (IHX) passage arranged between the drier housing and the inner surface; and
  - a cap member mounted to the RD shell across the opening, the cap member including an evaporator inlet fluidically connected to the evaporator outlet portion, an evaporator outlet fluidically connected to the evaporator inlet portion, a condenser inlet fluidically connected to the condenser outlet portion and a compressor outlet fluidically connected to the compressor inlet portion;
  - a first conduit extending into the drier housing from the cap member, the first conduit being fluidically connected to the condenser inlet; and
  - a second conduit extending into the drier housing from the cap member, the second conduit being fluidically connected to the evaporator outlet portion.

10. The climate control system according to claim 9, further comprising: a selectively removable expansion valve mounted in the cap member.

11. The climate control system according to claim 9, further comprising: at least one sensor mounted to the cap member.

12. The climate control system according to claim 9, further comprising: a high side charge port mounted to the cap member and a low side charge port mounted to the cap member.

13. The climate control system according to claim 9, wherein the drier housing includes a selectively removable desiccant.

14. The climate control system according to claim 13, wherein the second conduit includes a first end, a second end an intermediate portion extending through the drier housing, the second end being fluidically connected to the evaporator outlet.

15. A vehicle comprising:  
a chassis;

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a body supported by the chassis, the body including a motor compartment and an occupant zone; and  
a climate control system supported by the body, the climate control system comprising:

- a condenser arranged in the motor compartment, the condenser including a condenser outlet portion;
- a compressor arranged in the motor compartment, the compressor including a compressor inlet portion and a compressor outlet portion, the compressor outlet portion being fluidically connected to the condenser;
- an evaporator arranged in the occupant zone, the evaporator including an evaporator inlet portion and an evaporator outlet portion; and
- a valve-in-receiver (VIR) fluidically coupled to the condenser, the compressor and the evaporator, the VIR comprising:
  - a receiver drier (RD) shell including an outer surface and an inner surface defining an interior portion having an opening;
  - a drier housing arranged in the interior portion;
  - an internal heat exchanger (IHX) passage arranged between the drier housing and the inner surface; and
  - a cap member mounted to the RD shell across the opening, the cap member including an evaporator inlet fluidically connected to the evaporator outlet portion, an evaporator outlet fluidically connected to the evaporator inlet portion, a condenser inlet fluidically connected to the condenser outlet portion and a compressor outlet fluidically connected to the compressor inlet portion;
  - a first conduit extending into the drier housing from the cap member, the first conduit being fluidically connected to the condenser inlet; and
  - a second conduit extending into the drier housing from the cap member, the second conduit being fluidically connected to the evaporator outlet portion.

16. The climate control system according to claim 15, further comprising: a selectively removable expansion valve mounted in the cap member.

17. The vehicle according to claim 16, further comprising: at least one sensor mounted to the cap member.

18. The vehicle according to claim 16, further comprising: a high side charge port mounted to the cap member and a low side charge port mounted to the cap member.

19. The vehicle according to claim 18, wherein the second conduit includes a first end, a second end an intermediate portion extending through the drier housing, the second end being fluidically connected to the evaporator outlet portion.

20. The vehicle according to claim 16, wherein the drier housing includes a selectively removable desiccant.

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